
New Species of *Pentacalia* (Senecioneae: Asteraceae) from Ecuador, Peru, and Bolivia

Harold Robinson and José Cuatrecasas

Department of Botany, National Museum of Natural History, Smithsonian Institution,
Washington, D.C. 20560, U.S.A.

ABSTRACT. Twelve new species of *Pentacalia* are described from Ecuador: *P. carmelana*, *P. cazaletii*, *P. dodsonii*, *P. dorrii*, *P. hurtadoi*, *P. luteynorum*, *P. moronensis*, *P. napoensis*, *P. pailasensis*, *P. palaciosii*, *P. zakii*, *P. zamorana*; nine new species are described from Peru: *P. balsasana*, *P. cutervonis*, *P. davidsmithii*, *P. maynasensis*, *P. mucronatifolia*, *P. nunezii*, *P. sagasteguii*, *P. tilletii*, and *P. todziae*; and two new species are described from Bolivia: *P. inquisiviensis* and *P. lewisi*. *Gynoxys vargasiana* Cabrera of Peru is transferred to *Pentacalia*. Keys are provided for the species of *Pentacalia* subg. *Pentacalia* in Ecuador and Peru.

Over a period of years since the resurrection of the genus *Pentacalia* Cassini (Robinson & Cuatrecasas, 1978; Cuatrecasas, 1981; Robinson in Proctor, 1982), a number of undescribed species, mostly of the subgenus *Pentacalia*, have been set aside awaiting review. Progress on a study of *Pentacalia* in Colombia by Diaz-Piedrahita and Cuatrecasas (in prep.) has furnished a basis for comparison with unidentified specimens. The opportunity has been taken to describe twelve new Ecuadorian species, nine new Peruvian species, and two new Bolivian species. The large number of undescribed species is one indication of the generally inadequate treatment of Asteraceae of the tropical forests.

As seen in Cuatrecasas (1981), there have been 13 species of subgenus *Pentacalia* claimed from Ecuador, to which should be added *P. floribunda*, which was listed under subgenus *Microchaete*. In addition to the new species, in our review of *Pentacalia* subg. *Pentacalia* in Ecuador we have encountered recent collections of some other rarely collected Ecuadorian species: *P. andrei* (Greenman) J. Cuatrecasas, Zamora-Chinchipe, limit of Parque Nacional Podocarpus, around pass on road Loja-Zamora, alt. 2,750–2,950 m, 25 Dec. 1988, Madsen & Ellemann 75982 (AAU, QCA, US). *Pentacalia corazonensis* (Hieronymus) J. Cuatrecasas, Cotopaxi: Quevedo-Latacunga road, Páramos de Zumbagua, 19 km E of Pilaló and 78 km W of

Latacunga, elev. 3,536 m, 25 Dec. 1978, Luteyn & Luteyn 6510 (NY, MO); Loja: road to Zamora from Loja, km 12–14, near top of pass, elev. 2,800 m, 28 Sep. 1961, Dodson & Thien 779 (US). *Pentacalia lanceolifolia* (J. Cuatrecasas) J. Cuatrecasas, Loja: Parque Nacional Podocarpus, Cerro Toledo, 2,500–3,400 m, 30–31 Oct. 1989, Madsen 86250 (AAU, QCA, US). *Pentacalia millei* (Greenman) J. Cuatrecasas, Loja: Parque Nacional Podocarpus, 2,750–2,850 m, 4 May 1984, Øllgaard, Madsen & Christensen 74195 (AAU, QCA, US); Loja: Parque Nacional Podocarpus, E of Nudo de Cajanuma, trail E of “Centro de Informacion” to crest on trail to Laguna de Compadre, 2,850–3,050 m, 7 June 1988, Øllgaard 74631 (AAU, QCA); Parque Nacional Podocarpus, new road Loja-Zamora, E of Cerro Yanococha, along former Indian trail to Zamora, 2,550–2,650 m, 26 Nov. 1988, Madsen 75586 (AAU, QCA); Parque Nacional Podocarpus, road Yangana-Valladolid, km 21, alt. 2,700 m, 10 Nov. 1989, Madsen 86403 (AAU, QCA). *Pentacalia sevillana* (J. Cuatrecasas) J. Cuatrecasas, Loja: 7 km N of San Lucas on road to Loja, elev. 8,800 ft., 27 Jan. 1979, R. M. King & F. Almeda 7841 (US).

Cuatrecasas (1981) listed 20 members of *Pentacalia* subg. *Pentacalia* in Peru. Nineteen of these species are treated by Cabrera (1954) in the key to scandent *Senecio* species of Peru and Bolivia. Nine new Peruvian species of *Pentacalia* subg. *Pentacalia* are described here, and a new key is provided. In addition, the primarily Ecuadorian *P. disciformis* (Hieronymus) J. Cuatrecasas has been seen from northern Peru: Piura, Cerro Aypate, 49 km E of Ayabaca, 2,750 m, 22 Sep. 1991, Gentry, Diaz & Ortiz 7471 (MO, US).

The species occurring in Bolivia are also treated in the key by Cabrera (1985). Eighteen species were included, many of which also occur in Peru. Two new Bolivian species are described here with reference to their placement in the Cabrera key.

In the following descriptions the height of the heads is measured from the top of the peduncle to the tips of the disk corollas.

A NEW SPECIES OF *PENTACALIA* (SUBG. *MICROCHAETE*)
IN ECUADOR

Pentacalia (subg. *Microchaete*) **dodsonii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Zamora: road from Loja to Zamora, elev. 2,800 m, 18 Sep. 1961, *Dodson & Thien* 676 (holotype, SEL).

P. onae et *P. scitophyllae* simila sed in bracteis involucri paucioribus distincta.

Shrub 0.7–1.7 m high, moderately branched; stems dark brown, densely pilose with stout, blunt hairs or nearly glabrous; internodes ca. 1 cm long; pith solid. Leaves alternate; petioles 0.5–1.0 cm long, with few to many short, stout hairs; blades oblong-elliptical, mostly 6–7 cm long, 1.6–3.0 cm wide, base short-acute, margins closely serrate, apex shortly and sometimes narrowly acuminate, both surfaces with network of veinlets raised slightly above surface, irregularly pilose to nearly glabrous, lower surface paler green, with 7 or 8 prominent, strongly ascending secondary veins on each side. Inflorescences terminal on leafy branches, broadly corymbose with numerous branches; peduncles 1.2–2.5 cm long, usually with numerous narrowly subulate bracteoles 2–3 mm long, with 2–4 bracteoles forming calyx. Heads heterogamous, radiate, 9–10 mm high; involucral bracts 8, broadly oblong, 4–5 mm long, ca. 2 mm wide, apex obtuse to short-acute, glabrous; rays 8, corollas yellow, glabrous, basal tube ca. 4.5 mm long, limb large, ca. 10 mm long, 3.5 mm wide. Disk florets ca. 17; corollas ca. 6.5 mm long, basal tube ca. 2 mm long, throat ca. 2.5 mm long, lobes ca. 1 mm long, 0.7–0.9 mm wide at base, tips slightly thickened with sclerified shield of many slightly bulging, moderately enlarged cells outside; anther thecae ca. 2 mm long, very shortly pointed at base; backs of style branches with papillae continuing onto upper shaft of style. Achenes ca. 3 mm long, glabrous; pappus bristles mostly ca. 5 mm long with broadened tips of somewhat enlarged fusiform cells. Pollen grains ca. 35 μm diam.

The new species resembles the closely related *Pentacalia onae* (J. Cuatrecasas) J. Cuatrecasas and *P. scitophylla* (HBK) J. Cuatrecasas in general aspect but differs most obviously in having only ca. 8 bracts in the involucre instead of ca. 13. The backs of the style branches have papillae along their entire length and onto the upper part of the style shaft. The latter papillae are presumably like those of other species of *Pentacalia* subg. *Microchaete*, but they are unlike any *Pentacalia* subg. *Pentacalia* described below. None of the following species have

papillae on the backs of the style branches continued to the base.

Paratypes. ECUADOR. **Loja:** road to Zamora from Loja, km 12–14, elev. 2,800 m, near top of pass, shrub 4–5 ft. high, 28 Sep. 1961, *Dodson & Thien* 778 (SEL). **Loja/Zamora-Chinchipe:** limit of Parque Nacional Podocarpus, around pass on road Loja-Zamora, wet elfin forest, scrub-paramo and treeless ridgeline vegetation, 79°07'W, 03°58'S, 2,900 m, 8 Jan. 1989, shrub, *Madsen* 85480 (AAU).

NEW SPECIES OF *PENTACALIA* (SUBG. *PENTACALIA*) IN
ECUADOR

Pentacalia (subg. *Pentacalia*) **carmelana** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Napo: Cartagena, km 25 from El Carmelo on road toward La Bonita, 77°30'W, 0°37'N, alt. ca. 2,800 m, 13 Apr. 1979, *Løjtnant, Molau & Madison* 12335 (holotype, AAU).

In foliis late ovatis sparse vel distinete crispe hirtellis in capitulis radiatis et in floribus staminodeiferis distincta.

Plants scandent, indefinitely elongate; stems densely hirtellous with short brownish hairs, not or weakly fistulose. Leaves alternate, petioles 1.2–1.7 cm long, stout, densely hirtellous with stout hairs; blade thinly coriaceous, broadly oblong-ovate, ca. 9 cm long, ca. 6.5 cm wide, base broadly rounded, margins entire, slightly reflexed, apex rounded with minute apiculus, upper surface nearly smooth, slightly shiny, with few hairs mostly on veins, lower surface with numerous short crisped hairs on veins, with sparse hairs between veins; secondary veins prominent, 4 or 5 on each side, spreading at ca. 50°, arching, veinlets scarcely raised above surface. Inflorescences mostly lateral from axils of vegetative leaves, ca. twice as long as leaves, with foliose bracts in basal half, blades to 3.5 cm long, ca. 2.5 cm wide; distally a rounded or pyramidal thyrroid panicle, with branches corymbose; peduncles 3–7 mm long, densely puberulous. Heads 9–10 mm high, heterogamous, radiate; subinvolucral and calycular bracts minute, subulate, mostly 1.5 mm long, with few minute hairs; involucral bracts ca. 8, glabrous, ca. 6 mm long, 1.5 mm wide, apices short-acute. Ray florets ca. 6; corollas yellow, glabrous, tube 5–6 mm long, limb ca. 5 mm long, usually with 2 minute staminodia. Disk florets 15–18; corollas yellow, glabrous, tube ca. 4 mm long, throat ca. 2 mm long, lobes ca. 2 mm long, 0.55 mm wide, moderately thickened at tip with sclerified shield of many enlarged, bulging cells outside; anther thecae ca. 1.5 mm long, basal tails nearly as long as collar; apical appendage oblong, ca. 0.3 mm long, 0.15

mm wide. Achenes ca. 2 mm long, 5-ribbed, glabrous; pappus bristles 5–6 mm long, tips not broadened, often nearly smooth. Pollen grains ca. 30 μm diam.

The single known specimen is cited from a dense, mossy cloud forest. In Ecuador the species seems most similar to other radiate species with lateral inflorescences, *P. huilensis* and *P. riotintis*, but the latter are more glabrous and lack the large foliose bracts on the bases of their inflorescences.

Pentacalia (subg. *Pentacalia*) **cazaletii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Pichincha: 20 km W of Santo Domingo de los Colorados, alt. 1,000 ft., 18 Oct. 1961, Cazalet & Pennington 5064 (holotype, US; isotypes, B, K, NY).

In nervis secundariis foliorum obscuris in inflorescentibus axillaribus thyrsoides bracteiferis et in capitulis heterogamis disciformis distincta.

Plants scandent, indefinitely elongate; stems glabrous or glabrescent, with solid pith. Leaves alternate, petioles 0.7–1.1 cm long; blade fleshy, drying thinly subcoriaceous, ovate-elliptical, 8–10 cm long, 3.0–4.2 cm wide, base and apex short-acute, margins entire, upper and lower surfaces glabrous and smooth, only midvein prominent below, secondary veins 5–6 on each side, ascending and arching, obscure. Inflorescences lateral from axils of vegetative leaves, one and a half to three times as long as leaves, pyramidal thyrsoid, bracts foliiform, oblong-elliptical, mostly 2–5 cm long, 0.8–2.0 cm wide, apices obtuse with slight mucro; branches spreading at about 45°; peduncles 0–4 mm long, sparsely tomentellous. Heads ca. 8 mm high, heterogamous, disciform; subinvolucral and calycular bracteoles ca. 7, subulate, ca. 2.5 mm long, ca. 0.8 mm wide; involucral bracts 8, ca. 6 mm long, ca. 1 mm wide, apices acute, glabrous. Female florets 4, tubular; corollas yellow, glabrous, 5.0–5.5 mm long, tube ca. 3.5 mm long, lobes linear, ca. 1.8 mm long. Disk florets 8 or 9; corollas yellow, glabrous, 6.0–6.5 mm long, tube ca. 3 mm long, throat ca. 1.8 mm long, lobes narrowly oblong, 1.5–1.8 mm long, 0.40–0.45 mm wide, tips minimally thickened with subsclerified shield of large, somewhat bulging cells outside; anther thecae ca. 1.5 mm long, basal tails ca. two-thirds as long as collar; apical appendage oblong, ca. 0.3 mm long, 0.12–0.15 mm wide. Achenes ca. 1.5 mm long, glabrous; pappus bristles ca. 7 mm long, with apical cells not or scarcely broadened. Pollen grains ca. 27 μm diam.

The holotype is cited from a seasonal rainforest,

as an “epiphyte on a dead 50 ft. tree.” The paratype is cited from “Bosque muy húmedo Montano Bajo.” The fleshy, glabrous, elliptical leaves can be distinguished from many species of *Pentacalia* by the obscurity of the upwardly ascending secondary veins. The elongate, thyrsoid, bractiferous lateral inflorescences and the small heads bearing disciform rays are distinctive. The species is evidently restricted to the western side of the Andes.

Paratype. ECUADOR. **Pichincha:** Quito Canton, Chiriboga, en la carretera vieja a Santo Domingo, Reserva Forestal “La Favorita” del Ministerio Agric., 78°47'W, 00°12'S, 1,600–1,800 m, 8 Mar. 1990, Cerón, Ayala & Jimenez 8937 (MO, US).

Pentacalia (subg. *Pentacalia*) **dorrii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Loja: road to Fierro Acru, N of Pichig (ca. 3°40'S, 79°15'W), 3,015–3,385 m, 15 July 1989, Dorr & Valdespino 6654 (holotype, US; isotype, NY).

In foliis obovatis base cuneatis in nervis secundariis ascendentibus in inflorescentiis terminalibus et capitulis radiatis distincta.

Scandent shrubs; stems glabrous, scarcely striate, partially fistulose. Leaves alternate, petioles 1.0–1.5 cm long, moderately swollen at base; blades thinly subcoriaceous, glabrous, obovate, broadest in distal third or fourth, 5.0–7.5 cm long, 1.5–2.5 cm wide, base narrowly cuneate, margins entire, apex obtuse to short-acute with small apiculus, surfaces with secondary veins slightly raised above surface and less strongly raised veinlets; secondary veins ca. 5 on each side, strongly ascending at 30–35°, somewhat indistinct from reticulum of veinlets forming elongated areoles. Inflorescences terminal, broadly corymbose, with stem slightly inflated in lower part, only lowest branches from axils of reduced leaves, bracts above base small, subulate; peduncles 3–8 mm long, minutely puberulous. Heads 10–12 mm high, heterogamous, radiate; subinvolucral and 4 or 5 calycular bracts subulate, glabrous, to 1.5 mm long; involucral bracts ca. 8, glabrous, ca. 7 mm long, 1.5 mm wide, apices short-acute. Ray florets 5; corollas yellow, glabrous, tube ca. 5 mm long, limb 8–9 mm long. Disk florets ca. 9; corollas yellow, ca. 10 mm long, tube ca. 3 mm long, throat ca. 5 mm long, lobes ca. 1.5 mm long, 0.8 mm wide, lobes thickened equally to tip, tip with sclerified shield of scarcely bulging cells outside; anther thecae ca. 2.8 mm long, basal tails often longer than collar, apical appendage narrowly oblong, ca. 0.6 mm long, 0.3 mm wide. Achenes submature, ca. 2 mm long, glabrous, weakly 5-ribbed;

pappus bristles 7–8 mm long, slightly but distinctly broader and more roughened at tips. Pollen ca. 35 μm diam.

The new species has the general appearance of many of the glabrous, fleshy-leaved members of *Pentacalia*, but it is distinctive in the strongly obovate leaf blades with strongly ascending secondary veins. Its closest relation may be to *P. corazonensis*, an Ecuadorian species with similar terminal inflorescences and radiate heads. The latter has leaves that are distinctive in their oblong shape and rounded apices. The veins of the latter are more prominent in all the specimens seen. The slight enlargement of the stem in the base of the inflorescence is reminiscent of the condition in *P. luteynorum* described below, but the latter has obscure secondary veins in the leaves and smaller heads with whitish rays. As noted on the specimen by Pruski, there is a close match with a type photograph of *Senecio willdenowii* Schultz Bip. in Berlin, which differs only in less blunt leaf apices. The latter name has never been validly published.

Pentacalia (subg. *Pentacalia*) **hurtadoi** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Napo: 3 km este del Caserío de Huamání, al norte de la carretera Hollín-Loreta, por una trocha, 00°43'S, 77°36'W, 1,200 m, 17 Sep. 1988, Hurtado & Alvarado 302 (holotype, US; isotype, MO).

In foliis glabris in nervis secundariis pinnatis prominentibus arcuatis in inflorescentiis axillaribus plerumque racemiformis et in capitulis homogamis distincta.

Plants scandent, indefinitely elongate; stems glabrous, with solid pith. Leaves alternate, petioles 1.2–1.7 cm long; blades subcoriaceous, glabrous, ovate-elliptical to elliptical, 10–12 cm long, 3.5–4.5 cm wide, base short-acute, margins entire, apex apiculate, upper surface nearly smooth, on each side with ca. 6 arching secondary veins prominent on lower surface, intervening veins sometimes rather prominent. Inflorescences lateral, from axils of vegetative leaves, usually somewhat shorter than leaves, cylindrical, mostly racemiform, thyrsoid at base; peduncles 3–7 mm long, finely puberulous. Heads 10–11 mm high, homogamous; calycular bracts ca. 4, glabrous, 2–3 mm long, ca. 0.5 mm wide; involucral bracts ca. 8, glabrous, 7–8 mm long, 1.0–1.5 mm wide, apices short-acute. Ray florets lacking; disk florets ca. 15; corollas yellow, glabrous, ca. 8 mm long, tube ca. 4 mm long, throat ca. 2 mm long, lobe ca. 2 mm long and 0.6 mm wide, tips somewhat thickened with sclerified shield of

large, slightly bulging cells outside; anther thecae ca. 2 mm long, with basal tails as long as collar; apical anther appendage narrowly oblong, ca. 0.4 mm long, ca. 0.12 mm wide. Achenes ca. 1.8 mm long, glabrous; pappus bristles ca. 7 mm long, not broadened at tips, without enlarged apical cells. Pollen grains ca. 30 μm diam.

The two available specimens of this species were obviously collected during the same trip to the Volcán Sumaco area. The habitats were given as primary and secondary forest, and humid or pluvial premontane forest.

The species is one of the few described here from Ecuador without either ligulate or disciform rays. The glabrous leaves with prominent, arching, secondary veins, and the short, lateral, mostly racemiform inflorescences are distinctive. A number of species with lateral inflorescences occur in Ecuador and Peru, but such species are rare in Colombia. One species in Colombia with lateral inflorescences, *P. uribei* J. Cuatrecasas, is very similar to *P. hurtadoi* in form of the leafy branches and the inflorescences with homogamous heads, but it has shorter involucral bracts and a mixed indument of erect pilosity with persistent bases and tenuous arachnoid hairs on the leaves (Cuatrecasas, 1985).

Paratype. ECUADOR. Napo: carretera Hollín-Loreto, 5 km al W de Guamání, faldas del Volcán Sumaco, 00°43'S, 77°38'W, 1,200 m, 6–7 Sep. 1988, Neill, Hurtado & Alvarado 8558 (MO, US).

Pentacalia (subg. *Pentacalia*) **luteynorum** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Napo-Pastaza: Baeza-Tena road, remnant forest patches and roadside slopes from Cosanga to 5 km S of Cosanga, 1,975–2,225 m, 9 Jan. 1979, Luteyn & Lebrón-Luteyn 6733 (holotype, US; isotype, NY).

In foliis ellipticis glabris, in nervis secundariis obscuris in caulis in partibus fertilibus inflatis in inflorescentiis terminalibus et in radiis elongatis albis distincta.

Scrambling subshrubs or vines 2 m high or longer; stems terete, finely puberulous, becoming glabrous and slightly but distinctly inflated near base of inflorescence, with solid pith. Leaves alternate, petioles 0.7–1.0 cm long; blades fleshy, drying thinly subcoriaceous, elliptical, 5.5–9.0 cm long, 2.0–3.7 cm wide, base short-acute, margins entire, apex short-acuminate, upper and lower surfaces glabrous, with only midvein prominent below; 5 or 6 obscure, upwardly directed, secondary veins on each side. Inflorescence terminal, broadly corymbose to broadly pyramidal; foliose primary bracts on broadened stem

below inflorescence and at lower branches of inflorescence, lower bracts with petioles to 0.5 cm long, upper bracts sessile; blades glabrous, oblong, 2–4 cm long, 0.4–1.7 cm wide, apically obtuse; lower branches long and unbranched basally, corymbose distally, distal branches with short unbranched basal parts; peduncles 3–8 mm long, finely puberulous. Heads 8–9 mm high, heterogamous, radiate; sub-involucral and calycular bracts 5–8, subulate, minute, 0.8–1.5 mm long, 0.5–1.0 mm wide; involucral bracts ca. 8, oblong, ca. 5 mm long, 1.0–1.3 mm wide, apices rounded or obtuse, very sparsely puberulous. Ray florets ca. 8; corollas white, glabrous, tube 3.0–3.5 mm long, limb 3.5–4.0 mm long, with 1 or 2 minute staminodia. Disk florets ca. 15; corollas yellow, tube ca. 2 mm long, throat ca. 2 mm long, lobes ca. 1.2 mm long, ca. 0.5 mm wide, tips somewhat thickened with sclerified shield of enlarged bulging cells outside; anther thecae ca. 1.3 mm long, basal tails half to two-thirds as long as collar, apical appendage narrowly oblong, ca. 0.25 mm long, 0.15 mm wide. Achenes submature, ca. 1 mm long, glabrous; pappus bristles 4.5–5.0 mm long, tips not or scarcely broadened. Pollen grains ca. 27 μm diam.

The paratype is cited from disturbed forest. The specimens of this species have been referred previously to cf. *Pentacalia jelskii* (Hieronymus) J. Cuatrecasas of Bolivia and southern Peru, which has an elongate inflorescence and disciform or very shortly radiate heads, and *P. huilensis* (J. Cuatrecasas) J. Cuatrecasas of Colombia, which has more prominent secondary leaf veins, a more condensed inflorescence, and yellow rays. The new species seems to have a number of distinctive features, including the somewhat swollen stem at the base of the inflorescence and the white rays with minute staminodia. The species is named after the collectors of the type.

Paratype. ECUADOR. Napo: Cantón Quijos, along camino from Cosanga to Río Aliso, ca. 5 km W of Cosanga, approx. 77°53'W, 0°30'S, 2,000 m, 20 Feb. 1978, Kirkbride & Chamba 4255 (US).

Pentacalia (subg. *Pentacalia*) **moronensis** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Morona-Santiago: along new road Mendez-Morona, km 55–62, 800 m, 23 Aug. 1989, van der Werff & Gudiño 11385 (holotype, US; isotype, MO).

In caulibus fistulosis in foliis carnosis glabris in inflorescentiis lateralibus elongatis racemoso-thyrsoideis et in capitulis homogamis distincta.

Plants scandent, indefinitely elongate; stems terete, rather straight, glabrous, fistulose. Leaves al-

ternate, petioles 1.5–3.0 cm long; blades fleshy, drying coriaceous, oblong-elliptical, 12–16 cm long, 7.5–8.5 cm wide in type, 3.7–5.5 cm wide in paratypes, base shortly obtuse, short-acute in paratypes, margins entire, apex very short-acuminate, except at midvein surface smooth, glabrous, secondary veins obscure, ca. 5 on each side, spreading at ca. 45°. Inflorescences lateral, slightly longer than subtending leaves, narrowly racemiform-thrysoid with many branches along entire length; bracteoles minute, linear, to 2 mm long; peduncles mostly 4–8 mm long, minutely puberulous. Heads 9–12 mm high, homogamous, with somewhat turbinate bases; calycular bracts 2 or 3, subulate, to 3.5 mm long, glabrous; involucral bracts usually 8, glabrous, 8–10 mm long, 1.5–2.0 mm wide, short-acute. Ray florets lacking; disk florets 15–23; corollas yellow, glabrous, 8–9 mm long, tube 3–4 mm long, throat ca. 3 mm long, lobes ca. 1.8 mm long and 0.6–0.7 mm wide, tips minimally thickened with sclerified shield of large, bulging cells outside; anther thecae ca. 2 mm long, basal tails three-fourths as long as collar; apical anther appendage ca. 0.45 mm long, 0.12 mm wide. Achenes immature, ca. 1 mm long, glabrous; pappus bristles 8–9 mm long, not broadened at tips in 11385, broadened with short pointed cells in 4751 and 11260. Pollen grains 35–37 μm diam.

The specimens of this species are cited from lomas, in humid, tropical, primary forest and forest remnants. The new species seems closest to *P. nigella* (Badillo) J. Cuatrecasas of Venezuela, which is similar in the straight, fistulose stems and homogamous heads, but which has a much less branched, racemiform and scarcely thyrsoid inflorescence. The heads of the new species have turbinate bases and the involucral bracts extend to the tips of the corollas, while the specimens seen of *P. nigella* have heads with rounded bases and corolla lobes distinctly exceeding the involucral bracts. The type specimen of the new species, van der Werff & Gudiño 11385, which has the most mature heads, is similar to *P. nigella* in the lack of enlarged tips on the pappus bristles, but the leaves are broadly oblong to 8.5 cm wide. The paratype specimens, which may prove varietally distinct, have leaf blades more narrowly oblong as in *P. nigella*, but have the tips of the pappus bristles enlarged with short, broad apical cells.

Paratypes. ECUADOR. Morona-Santiago: along road Mendez-Morona, km 30–35, 800 m, 19 Aug. 1989, van der Werff & Gudiño 11260 (MO, US); pazo petrolero "Garza" de Tenneco, 35 km (aprox.) al noreste de Montalvo, 01°49'S, 76°42'W, 260 m, 2–12 jul. 1989, Zak & Espinosa 4751 (MO, US).

Pentacalia (subg. *Pentacalia*) **napoensis** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Napo: 3 km este del Caserío de Huamní, al norte de la carretera Hollín–Loreto, por una trocha, 00°43'S, 77°36'W, 1,200 m, 17 Sep. 1988, Hurtado & Alvarado 478 (holotype, US; isotype, MO).

In foliis glabris in nervis secondariis ascendentibus in nervis et nervulis supra et subtus distincte dense prominulis in inflorescentiis lateralibus et in capitulis homogamis distincta.

Plants scandent, indefinitely elongate; stems glabrous, narrowly fistulose. Leaves alternate, petioles 1.3–2.0 cm long; blades thinly coriaceous, glabrous, elliptical, 8–11 cm long, mostly 3.0–4.8 cm wide, base and apex shortly and narrowly acuminate, margins entire, upper and lower surfaces with veinlets closely and distinctly raised above surface; secondary veins ca. 6 on each side, spreading at 35–40°. Inflorescence lateral, from axils of vegetative leaves, one and a half to two times as long as leaves, unbranched in basal 6 cm, narrowly thyrsoid distally; peduncles mostly 5–10 mm long, finely puberulous, with few subulate bracteoles ca. 1.5 mm long. Heads 12–14 mm high, homogamous; calycular bracts 3 or 4, similar to bracteoles; involucral bracts ca. 8, glabrous, 9–10 mm long, 1.0–1.3 mm wide, apices short-acute. Ray florets lacking; disk florets 12–14; corollas yellow, glabrous, 10–11 mm long, tube 4.5–5.0 mm long, throat 2.0–2.5 mm long, lobes ca. 1.5 mm long, 0.5 mm wide, tips not thickened, with subsclerified shield of large, somewhat bulging cells outside; anther collars not or scarcely inflated below; anther thecae ca. 1.5 mm long, with basal tails three-fourths as long as collar; apical anther appendage narrowly oblong, ca. 0.45 mm long, 0.12 mm wide. Achenes ca. 2.3 mm long, glabrous, faintly 7- or 8-ribbed; pappus bristles ca. 8 mm long, tapered at tips, without enlarged apical cells. Pollen grains ca. 28 μm diam.

The single known specimen of this species is cited from “bosque pluvial Premontano,” and “bosque primario.” The species seems most distinct in the glabrous elliptical leaves with ascending secondary veins and veinlets strongly raised above the surface. The narrowly racemiform-thyrsoid lateral inflorescences with narrow, homogamous heads are also somewhat distinctive.

Pentacalia (subg. *Pentacalia*) **pailasensis** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Santiago-Zamora: trail between Mirador and Pailas, 2,010–2,255 m, 9 Sep. 1943, Steyermark 54275 (holotype, F).

In foliis planis integris glabris in venulis prominulis in inflorescentiis lateralibus brevibus racemiformibus et in capitulis heterogamis disciformis differt.

Plants scandent, indefinitely elongate; stems weakly striate, sparsely puberulous when young, becoming glabrous, narrowly fistulose. Leaves alternate, petioles 0.6–0.9 cm long; blades not arched, not drying conduplicate, elliptical, weakly subcoriaceous, glabrous, mostly 7–10 cm long, 0.19–4.0 cm wide, base short-acute, margins entire, apex short-acuminate, veins prominent below, reticulum of veinlets slightly but distinctly raised above the surface; secondary veins ca. 6 on each side, spreading at 60–70°, arching upward and joining well inside of margin. Inflorescences lateral from axils of leaves, slightly less long than the leaves, unbranched basal part 2.0–2.5 cm long, weakly puberulous, distal part mostly racemiform, bearing small subulate or linear bractlets to 8 mm long, with heads solitary or in pairs on short lateral branches; peduncles lacking to 5 mm long, minutely puberulous. Heads 8–9 mm high, heterogamous, disciform; calycular bracts 2 or 3, narrowly subulate, 2–3 mm long, glabrous; involucral bracts ca. 8, glabrous, 5–6 mm long, 1–2 mm wide, short-acute. Female florets ca. 4; corollas yellow, tubular, glabrous, tube ca. 4 mm long, lobes ca. 1 mm long, ca. 0.4 mm wide at base. Disk florets ca. 16; corollas yellow, glabrous, tube ca. 3 mm long, throat ca. 2 mm long, lobes ca. 1.5 mm long, 0.5 mm wide, tips scarcely thickened with sclerified mamillose cells outside; anther collar with cells of the short, broadened base poorly thickened in material seen; anther thecae ca. 1.8 mm long, basal tails half to two-thirds as long as collar, apical appendage narrowly oblong, 0.28 mm long, ca. 0.01 mm wide. Achenes ca. 1.5 mm long, glabrous; pappus bristles 5–6 mm long, tips not broadened. Pollen grains 27–30 μm diam.

The new species keys out close to *Pentacalia sevillana* and seems most closely related to that species. The latter differs most obviously by its arched leaf blades that are commonly conduplicate when pressed, by the more ascending secondary veins that reach near the leaf margin, and by the much longer, mostly narrowly thyrsoid inflorescences with strictly sessile heads.

Pentacalia (subg. *Pentacalia*) **palaciosii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Napo: Canto El Chaco, margen derecha del Río Quijos, Finca “La Ave Brava” de Segundo Pacheco, 77°39'W, 00°12'S, 1,800–1,900 m, 7–10 Sep. 1990, Palacios 5303 (holotype, US; isotype, MO).

In foliis herbaceis vel tenuiter coriaceis in inflorescentiis pyramidaliter thyrsoides et in capitulis heterogamis disciformis distincta.

Plants scandent or shrubby, often indefinitely elongate; stems roughened by persistent bases of evanescent hairs, narrowly fistulose. Leaves alternate, petioles ca. 1.5 cm long, with rough surface; blades oblong-ovate, firmly herbaceous to thinly coriaceous, glabrous, 1.0–1.3 cm long, 4–5 cm wide, base obtuse to rounded with short acumination, margins entire, apex short-acuminate, upper surface dark, glabrous, with veins and veinlets scarcely raised above surface, lower surface somewhat paler, sparsely puberulous, with veins and veinlets distinctly raised above surface, included veinlets slightly raised above surface; secondary veins ca. 10 on each side, spreading at 60° or more. Inflorescence lateral from axils of leaves, nearly twice as long as leaves, bearing only reduced bracts, broadly thyrsoid with branches ascending at 30–60°, basal bracts elliptical, 3–4 cm long, 0.9–1.5 cm wide, upper bracts papery, mostly 0.5–1.5 cm long, 0.1–0.3 cm wide, more sharply acute; peduncles 0.7–1.3 cm long, minutely puberulous. Heads 9–10 mm high, heterogamous, disciform; subcalycular and calycular bracts 1 or 2, narrowly subulate, 3–4 mm long, glabrous; involucral bracts ca. 8, glabrous, ca. 8 mm long, 1.0–1.5 mm wide, apices short-acute. Female florets ca. 4; corollas yellow, tubular, tube ca. 6 mm long, lobes ca. 1.3 mm long, ca. 0.5 mm long at base. Disk florets ca. 20; corollas yellow, glabrous, tube 4–5 mm long, throat ca. 2 mm long, lobes ca. 1.3 mm long, 0.5–0.6 mm wide, tips not thickened, with nearly plain shield paved with large cells bearing central papillae outside; anther thecae ca. 1.5 mm long, basal tails half as long as collar, apical appendage narrowly oblong, ca. 0.3 mm long, 0.1 mm wide. Achenes ca. 1.8 mm long, glabrous; pappus bristles ca. 6 mm long, tips not broadened. Pollen grains ca. 30 µm diam.

In general aspect of leaf venation and position of inflorescences, the new species seems closest to *Pentacalia hurtadoi* described above, also from Napo. The leaves of the latter differ by the fewer secondary veins, the veinlets that are not prominent, the homogamous heads, and the shorter, more racemiform inflorescences without small leafy bracts near the base.

Pentacalia (subg. *Pentacalia*) **zakii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Pichincha: Reserva Floristica—Ecológico “Rio Guajalito,” km 59 de la carretera antigua Quito-Sto. Domingo de los Colorados, a 3.5 km

al NE de la carretera estribaciones occidentales del Volcán Pichincha, 00°13'53"S, 78°48'10"W, 1,800–2,200 m, 18 Sep. 1986, Zak 1213 (holotype, US; isotype, MO).

In foliis late oblongis integris glabris in inflorescentiis lateralibus axillaribus foliis longioribus distaliter corymbosis in capitulis subsessilibus heterogamis disciformibus distincta.

Plants scandent, indefinitely elongate; stems striated, sparsely and finely puberulous, producing many short adventitious roots, with solid pith. Leaves alternate, petioles ca. 1.8 cm long; blades herbaceous to thinly subcoriaceous, broadly oblong, 12–13 cm long, 5.5–6.0 cm wide, base obtuse with slight acumination, margins entire, apex subacute and short-acuminate, upper and lower surfaces with veins and veinlets slightly raised above surface, essentially glabrous, slightly paler below, with ca. 6 widely spreading, strongly arching secondary veins on each side. Inflorescences lateral from axils of vegetative leaves, half again as long as leaves, with long, unbranched, leafless basal part 10–12 cm long, corymbosely branched distally, branches ending with 2 or 3 subsessile heads; peduncles 0.5–1.0 mm long, finely puberulous. Heads 9–10 mm high, heterogamous, disciform; calycular bracts 2 or 3, subulate, ca. 1.5 mm long, glabrous; involucral bracts 7 or 8, glabrous, ca. 7 mm long, 1.0–1.3 mm wide, apices narrowly acute. Female florets ca. 4, tubular; corollas white, glabrous, ca. 6 mm long, tube ca. 4 mm long, lobes ca. 1.7 mm long, 0.4 mm wide. Disk florets ca. 10; corollas white, glabrous, 6.0–6.5 mm long, tube 3.0–3.5 mm long, throat ca. 1.5 mm long, lobes ca. 2 mm long, 0.5–0.6 mm wide, tips minimally thickened with subsclerified shield of large, somewhat bulging cells outside; anther thecae ca. 1.5 mm long, basal tails ca. half as long as collar, apical appendage narrowly oblong, ca. 0.35 mm long, 0.13 mm wide. Achenes 2.0–2.5 mm long, glabrous, usually 5-ribbed; pappus bristles 4.0–4.5 mm long, tips not or scarcely broadened. Pollen grains ca. 27 µm diam.

Pentacalia zakii seems closest to *P. huilensis* (J. Cuatrecasas) J. Cuatrecasas of western Colombia and cited here from Ecuador: Pichincha: Parroquia Nanegal, Webster & Castro 28943 (US). The latter species has leaf blades of similar texture and indument and lateral inflorescences with long, unbranched bases. *Pentacalia huilensis* differs primarily by having distinctly ligulate rays, but also has thicker and more ovate leaves with more ascending secondary veins. The presence of adventitious roots on the stem of the new species may be

variable, but no such roots have been seen in *P. huilensis*. The inflorescence of *P. huilensis* has a terminal, nearly sessile, corymbose inflorescence on the tapering tips of the stems in addition to the axillary lateral inflorescences, and the same form may be seen in the new species when more material is examined.

Pentacalia (subg. *Pentacalia*) **zamorana** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Ecuador. Zamora: road from Loja to Zamora, km 12–14, elev. 2,800 m, 18 Nov. 1961, Dodson & Thien 1375 (holotype, US; isotype, SEL).

In foliis acutissimis argute dentatis glabris in inflorescentiis terminalibus dense pyramidaliter paniculatis et in capitulis sessilibus heterogamis disciformis distincta.

Plants scandent, indefinitely elongate; stems glabrous, striate, not or narrowly fistulose. Leaves alternate, petioles 0.5–0.7 cm long; blades coriaceous, ovate, 3–6 cm long, 1.7–3.5 cm wide, base rounded, margins regularly and sharply dentate, apex apiculate, surfaces with veins and veinlets strongly to moderately raised above surface, glabrous or rarely with traces of evanescent arachnoid tomentum near midvein; secondary veins ca. 6 on each side, spreading at 75–85° angles. Inflorescences terminal, densely pyramidal with widely spreading lower branches,

with only small subulate bracts. Heads sessile in mostly small clusters, ca. 6 mm high, heterogamous, disciform; calycular bracts 3 or 4, subulate, 1.0–1.5 mm long, with few hairs; involucral bracts ca. 8, glabrous, ca. 4 mm long, 1.0–1.5 mm wide, apices obtuse to short-acute. Female florets 3 or 4; corollas white, tubular, glabrous, tube ca. 2.3 mm long, lobes ca. 0.8 mm long. Disk florets ca. 10; corollas white, glabrous, ca. 4.5 mm long, tube ca. 1.8 mm long, throat ca. 1.8 mm long, lobes ca. 1 mm long, 0.5 mm wide, tips somewhat thickened with sclerified shield of many narrow papillae outside; anther thecae ca. 1 mm long, with basal tails half as long as collar; apical anther appendage oblong, ca. 0.25 mm long, 0.17 mm wide. Achenes ca. 1.5 mm long, glabrous, 5-ribbed; pappus bristles ca. 4 mm long, without enlarged apical cells. Pollen grains ca. 30 µm diam.

The new species seems closest to *P. millei* from the same general area of southern Ecuador. The latter has only small teeth on the leaf margins and evanescent arachnoid tomentum on the leaf undersurface and the surface of the involucral bracts.

Paratype. ECUADOR. **Zamora**: road from Loja to Zamora, km 12–14, elev. 2,800 m, 18 Nov. 1961, Dodson & Thien 1375 (SEL).

KEY TO THE SPECIES OF *PENTACALIA* SUBG. *PENTACALIA* IN ECUADOR

- 1a. Heads with distinct rays.
 - 2a. Stem becoming slightly but distinctly inflated near base of the terminal inflorescence; inflorescence with primary bracts large, foliose, oblong; rays white *P. luteynorum* H. Robinson & J. Cuatrecasas
 - 2b. Stem not or scarcely swollen at base of inflorescence, usually without large primary bracts in terminal inflorescences; rays yellow.
 - 3a. Inflorescences mostly or completely lateral from axils of full-sized vegetative leaves.
 - 4a. Stems and leaf undersurfaces with numerous crisped hairs; lateral inflorescences with foliose bracts on basal part *P. carmelana* H. Robinson & J. Cuatrecasas
 - 4b. Stems and leaf surfaces essentially glabrous; lateral inflorescences without foliose bracts on basal part.
 - 5a. Involucral bracts ca. 8; veinlets of leaf blade often slightly raised above surface *P. huilensis* (J. Cuatrecasas) J. Cuatrecasas
 - 5b. Involucral bracts 5–7; leaf surface plane, with veinlets completely immersed *P. riotintis* (J. Cuatrecasas) J. Cuatrecasas
 - 3b. Inflorescences mostly or wholly terminal on leafy branches.
 - 6a. Leaves with tomentum spread over entire undersurface.
 - 7a. Leaves small, 2–5 cm long, ovate, blunt; stems and leaf undersurfaces rufotomentose *P. ruficaulis* (Greenman & J. Cuatrecasas) J. Cuatrecasas
 - 7b. Leaves large, mostly 6–14 cm long, ovate-oblong, blunt; stems and leaf undersurfaces thinly arachnoid tomentose *P. campii* (J. Cuatrecasas) J. Cuatrecasas
 - 6b. Leaves glabrous or with tomentum only on midrib beneath.
 - 8a. Leaf blades oblong or obovate, with apices rounded or obtuse to short-acute.
 - 9a. Leaf blades oblong, with bases obtuse to short-acute, apices often rounded; veinlets distinctly raised above the surface *P. corazonensis* (Hieronymus) J. Cuatrecasas
 - 9b. Leaf blades obovate, with cuneate bases, apices obtuse to short-acute; veinlets scarcely raised above surface *P. dorrii* H. Robinson & J. Cuatrecasas
 - 8b. Leaf blades ovate, with apices acute.
 - 10a. Leaf with trinervate venation; surface smooth, with veinlets not pellucid; margins entire *P. lanceolifolia* (J. Cuatrecasas) J. Cuatrecasas

- 10b. Leaf venation pinnate; surface with pellucid veinlets raised above surface; margins often with a few teeth *P. andrei* (Greenman) J. Cuatrecasas
- 1b. Heads disciform or homogamous, without obvious rays.
- 11a. Heads homogamous, all florets bisexual.
- 12a. Leaf margins entire; inflorescences mostly or wholly lateral from axils of full-sized leaves.
- 13a. Leaf blades elliptic or oblong, fleshy with secondary veins obscure; inflorescences loosely racemiform-thyrroid; corollas yellow *P. moronensis* H. Robinson & J. Cuatrecasas
- 13b. Leaf blades elliptical, with prominent secondary veins; inflorescences mostly racemiform; corollas white.
- 14a. Leaf blades smooth between secondary veins; pith of stems solid; secondary veins arching and joining well inside of margin .. *P. hurtadoi* H. Robinson & J. Cuatrecasas
- 14b. Leaf blades with veinlets raised above surface; stems fistulose; secondary veins rather evenly ascending almost to margin *P. napoensis* H. Robinson & J. Cuatrecasas
- 12b. Leaf margins with teeth; inflorescences terminal or subterminal from axils of reduced leaves.
- 15a. Leaf blades densely tomentose below; heads sessile; corollas yellow *P. gibbiflora* (J. Cuatrecasas) J. Cuatrecasas
- 15b. Leaf blades glabrous or sparsely pubescent below; heads pedunculate; corollas white or greenish white.
- 16a. Leaves narrowly ovate to elliptical *P. hitchcockii* (J. Cuatrecasas) J. Cuatrecasas
- 16b. Leaves ovate.
- 17a. Axis of inflorescence mostly straight; leaves with secondary veins spreading at nearly 90° *P. arborea* (HBK) H. Robinson & J. Cuatrecasas
- 17b. Axis of inflorescence ± zigzagged; leaves with secondary veins spreading at 70–80° angles *P. theaefolia* (Bentham) J. Cuatrecasas
- 11b. Heads heterogamous, with tubular peripheral female florets.
- 18a. Leaf margins denticulate; inflorescences terminal.
- 19a. Leaf blades large, to 20 cm long, with closely and acutely denticulate margins; heads pedunculate *P. floribunda* J. Cuatrecasas
- 19b. Leaf blades mostly less than 10 cm long, with less than 20 teeth on each margin; heads sessile.
- 20a. Undersurfaces of leaves with dense tomentum; branches of inflorescences often retroflexed, directed backward *P. oronocensis* (DC.) J. Cuatrecasas
- 20b. Undersurfaces of leaves glabrous or with evanescent arachnoid tomentum; branches of inflorescences not retroflexed.
- 21a. Margins of leaf blades with small mucronate-denticulations; stems, leaf undersurfaces, and inflorescences with distinct evanescent arachnoid tomentum *P. millei* (Greenman) J. Cuatrecasas
- 21b. Margins of leaf blades with numerous sharp teeth and intervening rounded sinuses; stems, leaves, and most of each inflorescence essentially glabrous *P. zamorana* H. Robinson & J. Cuatrecasas
- 18b. Leaf margins entire; inflorescences partially or wholly lateral from axils of full-sized vegetative leaves.
- 22a. Undersurfaces of leaf blades and involucral bracts pubescent.
- 23a. Heads 10–13 mm high from base of receptacle to tips of disk florets, with ca. 40 disk florets and 10–12 short-ligulate, 3–5-lobed peripheral female florets *P. hillii* (Greenman) J. Cuatrecasas
- 23b. Heads mostly 9–10 mm high, with 16–30 disk florets and 4–7 peripheral female florets.
- 24a. Peripheral female florets 6–7, tubular, 5-lobed; bisexual disk florets 25–30 *P. disciformis* (Hieronymus) J. Cuatrecasas
- 24b. Peripheral female florets ca. 4, subradiate, with deeply 3-lobed limb; bisexual disk florets 17–19 *P. carchiensis* (J. Cuatrecasas) J. Cuatrecasas
- 22b. Leaf blades and involucral bracts glabrous.
- 25a. Lateral inflorescences with naked, long, unbranched basal parts that are longer than distal branching part, corymbiform distally; leaves broadly oblong *P. zakii* H. Robinson & J. Cuatrecasas
- 25b. Lateral inflorescences with basal parts short or closely bractiferous, thyrsoid or racemiform distally; leaves ovate or elliptical.
- 26a. Leaf blades smooth except for midvein, secondary and tertiary veins obscure; corollas white *P. cazaletii* H. Robinson & J. Cuatrecasas
- 26b. Leaf blades with prominent secondary veins and weakly to strongly raised veinlets; corollas yellow or pale yellow.
- 27a. Heads loosely racemose, disposed on slender peduncles; bases of lateral inflorescences with foliose bracts *P. palaciosii* H. Robinson & J. Cuatrecasas

- 27b. Heads sessile or subsessile; bases of lateral inflorescences often with only small subulate bracts.
- 28a. Leaf blades somewhat arched, often conduplicate when pressed; secondary veins reaching near leaf margin; inflorescence longer than subtending leaves, distinctly thyrsoid with branches bearing many sessile heads . . . *P. sevillana* (J. Cuatrecasas) J. Cuatrecasas
- 28b. Leaf blades pressing flat; secondary veins strongly upwardly curved and joining well inside of margin; inflorescence not longer than subtending leaves, mostly racemiform with shortly pedunculate heads *P. pailasensis* H. Robinson & J. Cuatrecasas

NEW SPECIES OF *PENTACALIA* (SUBG. *PENTACALIA*)
IN PERU

Pentacalia (subg. *Pentacalia*) **balsasana** J. Cuatrecasas & H. Robinson, sp. nov. TYPE: Peru. Cajamarca: Celendín, Río Marañon, canyon above Balsas, 3–4 km below summit, rd. to Celendín, alt. 2,950 m, 21 May 1964, Hutchison & Wright 5212 (holotype, US; isotypes, F, UC, USM).

In nodis prominentibus in foliis oppositis in laminis oblongis base rotundatis vel breviter acutis subtus cinereotomentosis in capitulis radiatis et in bracteis involucri ca. 13 distincta.

Shrubs ca. 2 m high; stems somewhat hexagonal, thinly white-lanuginose, nodes appearing swollen with persistent enlarged bases of petioles, with solid pith. Leaves opposite, petioles 1.0–1.5 cm long, 0.8–1.3 cm wide above enlarged persistent bases; blades subcoriaceous, 2.5–8.0 cm long, 1.0–2.8 cm wide, base rounded to short-acute, margins with numerous minute, close denticulations, sinuses as wide as deep, apex obtuse to short-acute, upper surface shiny green with slight evanescent, whitish, arachnoid wool, lower surface covered with dense whitish tomentum; secondary veins ca. 8 on each side, widely spreading, reticulum of veinlets prominent below. Inflorescence terminal, and from axils of uppermost reduced leaves, broadly cymose with corymbose branches; peduncles 0.3–1.5(–2.7) cm long, thinly whitish tomentose. Heads 10–13 mm high, heterogamous, radiate; 8–10 calycular bracts and few subinvolucral bracteoles 3–4 mm long, 0.6–0.7 mm wide, with few arachnoid hairs, with tips acute and brownish, margins minutely ciliate; involucral bracts ca. 13, ca. 6 mm long, mostly oblong, 1.7–1.9 mm wide, outermost linear, ca. 1 mm wide, all glabrous with acute ciliate apices. Ray florets 10; corollas yellow, glabrous, 10–12 mm long, tube 3.0–3.5 mm long, limb oblong-elliptical, ca. 8 mm long, 2.2–2.4 mm wide. Disk florets ca. 29; corollas yellow, ca. 8 mm long, glabrous, tube ca. 3 mm long, throat ca. 5 mm long, lobes ca. 1 mm long, 0.8–0.9 mm wide, lobes scarcely thickened at tips with scarcely bulging cells out-

side; anther thecae ca. 2.5 mm long, basal tails a third and a half as long as collar, apical appendage oblong-ovate, ca. 0.4 mm long, 0.25 mm wide. Achenes submature, 2.5–3.0 mm long, glabrous, weakly 5-ribbed; pappus bristles ca. 6 mm long, with long-projecting but not broadened apical cells. Pollen 37–40 μm diam.

The type is described on the label as fairly common, fragrant, a shrub to 2 m, coarse, with leaves glossy above, woolly below, and leathery. *Pentacalia balsasana* is one of three species of this genus in Peru with opposite leaves. Of the others, *P. wurdackii* differs by being obviously a vine, by its lack of persistent petiole bases, its glabrous leaves, fewer involucral bracts, its lack of rays, and its more deeply cut corolla lobes. *Pentacalia vargasiana* from southern Peru is described as a shrub, but has cordate bases and sparse pubescence on the undersurfaces of the leaves, lacks the persistent petiole bases, has the shortest anther tails seen in the subgenus, and has longer corolla lobes with more thickened and roughened tips. The three species do not seem closely related.

Paratype. PERU. Cajamarca: Celendín, Río Marañon canyon, above Balsas, 3–4 km below summit on road to Celendín, alt. 2,950 m, 21 May 1964, Hutchison & Wright 5212A (F, UC, US, USM).

Pentacalia (subg. *Pentacalia*) **cutervonis** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Peru. Cajamarca: Cutervo National Park, 12 km NE of San Andres de Cutervo, transect 4, 06°10'S, 78°40'W, 2,230 m, 11 Sep. 1991, Gentry, Diaz & Ortiz 74653 (holotype, US; isotype, MO).

In foliis herbaceis vel subcoriaceis subtus puberulis in nervulis reticulato-prominulis in inflorescentiis lateralibus et in capitulis homogamis brevibus distincta.

Plants scandent, arborescent? to 12 m tall; stem pale, terete, finely striate, coarsely puberulous, with solid pith. Leaves alternate, petioles 1.2–1.4 cm long; blades herbaceous to thinly subcoriaceous, elliptical, 9–10 cm long, 3.0–3.8 cm wide, base acute,

margins entire, apex shortly and narrowly acuminate, surfaces with a distinct network of raised veinlets, glabrous above, sparsely puberulous below; ca. 7 secondary veins on each side, ascending at ca. 35°. Inflorescences lateral, from axils of vegetative leaves, usually somewhat shorter than leaves, narrowly thyrsoid, with short, few-headed lateral branches beyond basal third; peduncles 2–7 mm long, finely puberulous. Heads ca. 7 mm high, homogamous; few subinvolucral and calycular bracteoles subulate, 1.5–2.0 mm long, sparsely puberulous; involucre of flowering heads with partially spreading tips when dry; involucral bracts 8, sparsely, minutely puberulous outside, 4.5–5.0 mm long, 1.0–1.8 mm wide, subobtuse to short-acute. Ray florets lacking; disk florets ca. 12; corollas yellow, glabrous, ca. 7 mm long, tube ca. 3 mm long, throat ca. 1.5 mm long, lobes ca. 1.5 mm long, 0.6 mm wide, scarcely thickened at tip, nearly smooth outside; anther thecae ca. 1.3 mm long, with basal tails ca. half as long as collar; apical anther appendage narrowly oblong, ca. 0.45 mm long, ca. 0.13 mm wide. Achenes immature, ca. 0.8 mm long, glabrous, 5-ribbed; pappus bristles ca. 4.5 mm long, not broadened at tips. Pollen grains 35–37 μm diam.

The paratype specimen is cited from a humid cloud forest. The type is clearly stated to be a liana, but the paratype was collected in a tree fall and is described on the label as a tree to 12 m? The new species does not seem particularly close to others in Peru. In the shape of the leaf, the ascending secondary veins, the veinlets raised above the surface, the general form of the inflorescence, and the homogamous heads, the new species seems closest to *P. napoensis* described above from Ecuador. The latter species differs by its glabrous stems, leaves, and involucres, the mostly unbranched lateral branches of its inflorescences, and its shorter heads. The secondary veins of the present species seem somewhat less ascending than in the Ecuadorian species.

Paratype. PERU. **Amazonas:** Prov. Bagua, Cordillera Colán Se of La Peca, Third camp, elev. 5,900–6,125 ft., 17 Oct. 1978, Barbour 4124 (MO, US).

Pentacalia (subg. *Pentacalia*) **davidsmithii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Peru. Pasco: Prov. Oxapampa, near Cerro Pajonal, 24 km from Oxapampa, 2,580–2,600 m, 9 Oct. 1982, David N. Smith 2565 (holotype, US; isotype, MO).

In foliis coriaceis integris, in inflorescentiis terminalibus late ovoideis thyrsoidaeis in capitulis heterogamis radiatis

in bracteis involucralibus 10–13 et in cellulis apicalibus pappi inflatis distincta.

Scrambling or prostrate subshrubs, with branches several meters long; stems terete, striate, pale brownish tomentellous, broadly fistulose. Leaves alternate, petioles 0.5–1.7 cm long; blades somewhat fleshy, drying coriaceous, glabrous, elliptical, 7–13 cm long, 1.7–5.2 cm wide, base rounded-obtuse to acute, margins entire, scarcely reflexed, apex short-acuminate, subglabrous above with few small hairs mostly on midvein, very sparsely puberulous below; 5 or 6 secondary veins on each side spreading at 50–55°, scarcely raised above surface below, other venation obsolete. Inflorescence terminal, broadly rounded, thyrsoid, about as wide as high, with reduced leaves at lower nodes, smaller subsessile tomentellous foliaceous bracts at median nodes, progressively smaller, linear bracts at upper nodes 0.5–1.0 cm long; branches mostly unbranched in basal half or more, corymbose distally; peduncles 0.8–2.8 cm long, pale tomentellous. Heads 10–12 mm high, heterogamous, radiate; few subinvolucral and 4 or 5 calycular bracteoles subulate, 2.0–2.5 mm long, sparsely puberulous; involucre broadly campanulate, 6–7 mm wide; involucral bracts 10–13, tomentellous on much of surface, ca. 6 mm long, 1.3–1.8 mm wide, apices acute. Ray florets 8; corollas yellow, glabrous, tube ca. 5 mm long, limb ca. 10 mm long. Disk florets ca. 25; corollas yellow, glabrous, ca. 9.5 mm long, tube ca. 3.5 mm long, throat ca. 4.5 mm long, lobes ca. 2 mm long, 0.8 mm wide, thickened at tip with many bulging cells outside; anther thecae ca. 2.5 mm long, basal tails often slightly longer than collar; apical anther appendage oblong-ovate, ca. 0.4 mm long, 0.25 mm wide. Achenes ca. 1.8 mm long, glabrous, 5-ribbed; pappus bristles ca. 8 mm long, distally broadened at tips with many inflated apical cells. Pollen grains 47–50 μm diam.

The only known specimen of this species is cited from high montane moist forest. It is stated to have the “inflorescence erect, terminal or axillary (apparently by secondary dominance in horizontal branches).” The flowers are said to have a “sweet composite odor.” The new species is considered closest to the Peruvian *Pentacalia carpishensis* and *P. poyasensis*, which have leaves of similar shape and texture and heads with mostly 13 involucral bracts. Both the latter species have a marked tendency for lateral inflorescences and lack enlarged tips on the pappus bristles. *Pentacalia poyasensis* also usually has disciform heads, scarcely fistulose stems, and more glabrous stems, leaves, and involucres.

Pentacalia (subg. *Pentacalia*) **maynasensis** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Peru. Loreto: Prov. Maynas, Yanamono Explorama Tourist Camp, halfway between Indiana and mouth of Río Napo, 130 m, 2 Aug. 1988, *van der Werff, Vásquez & Jaramillo* 9937 (holotype, US; isotype, MO).

In foliis ovato-ellipticis in nervis secundariis ascendentes in capitulis heterogamis disciformibus et in involucris turbinatis distincta.

Plants scandent, to 15 m tall, indefinitely elongate; stem terete, striate, glabrous, fistulose. Leaves alternate, petioles slender, 1–2 cm long; blades herbaceous to subcoriaceous, glabrous, ovate-elliptical, mostly 5–9 cm long, 2–4 cm wide, base short-acute, margins entire, apex short-acuminate; 3 or 4 secondary veins on each side, ascending at 30–35°, slightly raised above surface below when dry, blades otherwise smooth. Inflorescence terminal, thyrsoid, ovoid, with reduced leaves or foliiform bracts at lower nodes; branches widely spreading, becoming narrowly pyramidal distally; peduncles 3–6 mm long, whitish tomentellous. Heads 10–11 mm high, heterogamous, disciform; subinvolucral and ca. 4 calycular bracteoles subulate, 2.0–2.5 mm long, essentially glabrous; involucre turbinate, broader in basal half, contracted above at anthesis; involucral bracts ca. 8, glabrous, ca. 7 mm long, 1.0–1.5 mm wide, short-acute. Female florets 4 or 5; corollas yellow, glabrous, tubular, tube ca. 5 mm long, throat ca. 2 mm long, lobes ca. 0.8 mm long, 0.25 mm wide. Disk florets 12–14; corollas yellow, glabrous, ca. 10 mm long, tube ca. 6 mm long, throat ca. 2 mm long, lobes ca. 1.5 mm long, 0.6 mm wide, scarcely thickened and with few bulging cells at tip; anther thecae ca. 1.8 mm long, with basal tail usually almost as long as collar; apical anther appendage narrowly oblong, ca. 0.2 mm long, ca. 0.1 mm wide. Achenes ca. 1.2 mm long, glabrous, 5-ribbed; pappus bristles ca. 8 mm long, distinctly broadened at tips, apical cells with short rounded projections. Pollen grains ca. 33 μm diam.

The only known specimen of this species is cited from nonflooded forest on rather fertile soil. The new species keys to *Pentacalia lucidissima* of Huánuco, Peru, in Cabrera (1954), but the latter has homogamous heads, lateral inflorescences, and midveins of leaves that are tomentellous. The enlarged tips of the longer pappus bristles of the new species may prove to be a useful distinction.

Pentacalia (subg. *Pentacalia*) **mucronatifolia** H. Robinson & J. Cuatrecasas, sp. nov. TYPE:

Peru. Amazonas: Luya Prov., Camporredondo-Tullanya, trocha hacia el Cerro Huicsocunga, 2,350 m, 2 Sep. 1989, *Díaz & Campos* 3704 (holotype, US; isotype, US).

In foliis ovato-oblongis prominulo-reticulatis apice abrupte apiculatis margine mucrono-denticulatis in inflorescentiis terminalibus dense pyramidalibus in ramulis spicatis et in capitulis sessilibus disciformibus non vel vix heterogamis distincta.

Plants scandent, indefinitely elongate; stems terete, striate, minutely puberulous, fistulose. Leaves alternate, petioles mostly rather short, 0.5–1.0 cm long; blades oblong-ovate, mostly 4.5–7.0 cm long, 3.5–5.0 cm wide, base broadly rounded, margins with few to many remote mucronate denticulations, apex rounded with abrupt, slender apiculus, upper and lower surface with prominent network of veinlets, sparsely puberulous or hispidulous, with very sparse arachnoid hairs; 6–8 secondary veins on each side, spreading at ca. 80°. Inflorescence terminal, pyramidal, with densely pyramidal branches; branchlets spicate with heads grouped in successive clusters; primary bracts linear to narrowly elliptical, 0.8–2.5 cm long. Heads sessile, ca. 7 mm high, often heterogamous, disciform; calycular bracts 5 or 6, linear, glabrous, 1.0–1.5 mm long; involucral bracts ca. 8, oblong, glabrous, 3.5–4.0 mm long, ca. 1 mm wide, acute. Female florets 0–1; corollas tubular, yellow, glabrous, tube ca. 2.5 mm long, lobes ca. 1 mm long. Disk florets ca. 8; corollas yellow, glabrous, 5.5–6.0 mm long, tube ca. 2 mm long, throat ca. 1.5 mm long, lobes ca. 1.2 mm long, 0.5 mm wide, moderately thickened at tip with cluster of many enlarged cells outside; anther thecae ca. 1.2 mm long, basal tails half as long to as long as collar, apical appendage ca. 0.35 mm long, 0.15 mm wide. Achenes ca. 1.5 mm long, glabrous; pappus bristles 3.5–4.0 mm long, tips not or scarcely broadened. Pollen grains ca. 27 μm diam.

The single collection of this species is cited from cloud forest. The species can be distinguished by the narrow abrupt apiculus of the leaves or by the densely pyramidal terminal inflorescence with heads sessile on rather spicate branchlets. The female florets in the heads are not obvious and seem to be lacking in many heads.

Pentacalia (subg. *Pentacalia*) **nunezii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Peru. Cusco: Urubamba, Machupicchu, a 107 km de Cusco, entre Wiñayhuyna e Intipunca, 13°09'S, 72°31'W, 2,900 m, 26 Oct. 1987, *Núñez* 8408 (holotype, US; isotype, MO).

In foliis herbaceis vel subcoriaceis oblongis integris subtus minime persparse tomentellis in inflorescentiis terminalibus ovoideis et in capitulis pedunculatis radiatis distincta.

Plants scandent, indefinitely elongate; stem terete and striate, becoming irregularly ridged, thinly tomentellous, with solid pith. Leaves alternate, petioles 0.5–1.0 cm long; blades herbaceous to subcoriaceous, oblong-elliptical, mostly 4–8 cm long, 1.2–3.2 cm wide, base short-acute, margins entire, slightly reflexed, apex obtuse to short-acute, often with slight apiculus, upper surface glabrous with puberulous midvein, lower surface scarcely paler, with sparse arachnoid puberulence, denser toward midvein; 8 or 9 widely spreading secondary veins on each side, veinlets slightly raised above surface. Inflorescence terminal and from axils of somewhat reduced upper leaves, thyrsoid, ovoid, with widely spreading branches ending in loose pyramidal clusters of heads; peduncles 5–15 mm long, densely puberulous. Heads 10–12 mm high, heterogamous, radiate; calycular bracts ca. 5, subulate to linear, 1.0–3.5 mm long, finely puberulous; involucral bracts ca. 13, tomentellous outside, oblong-lanceolate, 5–6 mm long, ca. 1.5 mm wide, acute. Ray florets ca. 10; corollas yellow, glabrous, tube 4–5 mm long, limb 8–9 mm long. Disk florets ca. 25; corollas yellow, tube ca. 3.5 mm long, throat ca. 3.5 mm long, lobes ca. 1 mm long, ca. 0.5 mm wide, thickened tip with many narrow papillae outside; anther thecae ca. 2.5 mm long, basal tails one-third to two-thirds as long as collar; anther appendage oblong, ca. 0.45 mm long, 0.23 mm wide. Achenes ca. 2.0–2.2 mm long, 5-ribbed; pappus bristles 6–7 mm long, with somewhat broadened, more scabrid tips. Pollen grains ca. 30 μm diam.

The single specimen of this species is cited from bosque de ceja de selva, with *Clethra*, *Podocarpus*, and *Alnus*. The new species keys to *Pentacalia carpishensis* in Cabrera (1954), but differs by the larger heads and the thinner and narrower leaf blades with denser, more crowded secondary veins. All specimens examined of *Pentacalia carpishensis* also differ by having lateral inflorescences.

Pentacalia (subg. *Pentacalia*) **sagasteguii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Peru. Cajamarca: Prov. Cajamarca, La Encanada, 2,750 m, 17 Aug. 1984, Sagástegui, Mostacero & Leiva 12012 (holotype, US; isotype, MO).

In foliis margine dense crenulo-denticulatis in reticulis venulosis distinctis in bracteis involuci ca. 13 in lobis

corollarum glanduliferis et in ductis resiniferis acheniorum prominentibus distincta.

Spreading subshrubs or shrubs, 2 m or more high; stems sparsely to densely puberulous, with solid pith. Leaves alternate, petioles 0.2–0.4 cm long, to 2 cm in paratypes *Sagástegui et al.* 9001 and *Hutchison & Wright* 5387; blades herbaceous, ovate to elliptical, 5–12 cm long, 1.5–4.5 cm wide, base acute to subobtuse, margins closely crenulate-denticulate, sometimes subentire in uppermost leaves, apex acute, upper surface scarcely to densely puberulous, with veinlets slightly insulcate, lower surface slightly paler with darker recessed reticulum of veinlets, sparsely puberulous on veinlets to brownish tomentose; secondary veins 6–8 on each side, spreading at 40–50°. Inflorescence terminal and from axils of reduced upper leaves, broadly pyramidal or rounded, with widely spreading branches; narrowly ovate to lanceolate foliiform bracts at bases of branches and branchlets 1–3 cm long, 0.5–1.3 cm wide; peduncles 4–18 mm long, densely puberulous. Heads 8–14 mm high, heterogamous, radiate; calycular bracts 4–6, herbaceous, linear, ca. 5 mm long, 1.0–1.2 mm wide, slightly shorter or longer than involucre, slightly to densely puberulous; involucral bracts ca. 13, ca. 5 mm long, 1.5–2.0 mm wide, acute, puberulous to subtomentose above. Ray florets 12–14; corollas yellow, glabrous, tube 3.5–4.5 mm long, limb 7.5–10.0 mm long. Disk florets 35–50; corollas yellow, mostly glabrous outside, tube 3.0–3.5 mm long, throat 4.0–4.5 mm long, lobes ca. 0.8 mm long, 0.7 mm wide, outer surface puberulous with small, cylindrical glands, tip somewhat thickened with moderately bulging cells outside; anther thecae ca. 2.5 mm long, basal tails ca. half as long as collar; apical appendage oblong-ovate, ca. 0.45 mm long, 0.25 mm wide; style tip with tuft of apical hairs, rather long in paratype 9001. Achenes 2–3 mm long, large bulging resin ducts over veins forming 5 prominent ribs, glabrous, sometimes with few short setulae between ribs in paratype 12183; pappus bristles ca. 6 mm long, tips broadened with cluster of enlarged, somewhat spreading, fusiform apical cells. Pollen grains 35–37 μm diam.

The specimens of this species are labeled as “arbusto” and “sufrútice,” but the stems on the sheets have an elongate appearance that suggests a spreading or scrambling habit.

Among the Peruvian species of *Pentacalia*, the new species keys near *P. tablensis* (Cabrera) J. Cuatrecasas, *P. nunezii*, and *P. davidsmithii* because of the terminal inflorescences, pedunculate heads, ca. 13 involucral bracts, and prominent rays. The present species differs from these by the closely

crenulate-denticulate margins of the leaves. The corolla lobes of the new species have cylindrical glandular hairs outside, which contrasts with the glabrous condition of the corollas in most other members of the subgenus. The three specimens show differences in a number of characters, but they share a number of features and seem to be one species. The achenes of the three specimens are mature, and all show prominent enlarged resin ducts forming the ribs over the veins. The tips of the pappus have rather large spreading cells in all three specimens. The achenes are mostly glabrous, but some short setulae are seen in *Sagástegui* 12183. The holotype and *Sagástegui et al.* 12183 have characteristically subsessile leaves. The third and fourth collections, *Sagástegui et al.* 9001 and *Hutchison & Wright* 5387, have distinct petioles to 2 cm long. The latter specimens also have comparatively long hairs on the apices of the style and more strongly serrulate leaf margins.

Paratypes. PERU. Cajamarca: Contumazá, Shamón, arriba de Contumazá, 2,800 m, 8 July 1977, *Sagástegui, Alvitez & Mostacero* 9001 (MO, US); Celendín, Gelig, Celendín—Balsas, 2,850 m, 18 Aug. 1984, *Sagástegui, Mostacero & Leiva* 12183 (MO, US); canyon of Río Marañon above Balsas, 6 km below summit of road to Celendín, 2,850 m, 27 May 1964, *Hutchison & Wright* 5387 (UC, US, USM).

Pentacalia (subg. *Pentacalia*) **tillettii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Peru. Amazonas: Prov. Pongará, Dist. Yambrasamba, 1,860–2,000 m, 2 Mar. 1967, *Tillett* 673-318 (holotype, US).

In foliis ovato-oblongis rigide carnosis in inflorescentiis lateralibus anguste cylindrice thyrsoides et in capitulis radiatis distincta.

Shrubby vines growing to 10 m or more; stems glabrous, with solid pith. Leaves alternate, petioles 1.3–2.3 cm long; blades fleshy, brittle, ovate-oblong, 6–9 cm long, mostly 3.5–6.0 cm wide, base rounded to obtuse, margins entire, narrowly revolute, apex obtuse with small apiculus, surfaces glabrous, only midvein prominent below; ca. 5 widely spreading, arched secondary veins visible when dry. Inflorescences lateral from axils of vegetative leaves, 3–4 times as long as leaves, without foliose bracts basally; primary bracts chartaceous, oblong, 5–11 mm long, obtuse to acute, minutely puberulous; the numerous short lateral branches corymbose; peduncles slender, 2–7 mm long, minutely puberulous. Heads ca. 8 mm high, heterogamous, radiate; calycular bracts 2 or 3, narrowly subulate, to 2.5 mm long, with few small hairs; involucral bracts ca. 8, glabrous, ca. 5 mm long, 1.0–1.5 mm wide, apices short-acute. Ray florets ca. 6; corollas yellow, glabrous,

tube ca. 4 mm long, limb ca. 4 mm long. Disk florets ca. 10; corollas yellow, ca. 7 mm long, tube ca. 3 mm long, throat 1.2–1.5 mm long, lobes ca. 2 mm long, ca. 0.5 mm wide, tips not thickened, with subsclerified small, somewhat bulging cells outside; anther thecae ca. 1.5 mm long, basal tail two-thirds as long as collar; apical appendage narrowly oblong, ca. 0.3 mm long, 0.12 mm wide. Achenes 2.0–2.2 mm long, glabrous, 5-costate; pappus bristles 4–5 mm long, tips not broadened. Pollen grains ca. 27 μm diam.

The label of the type and only known specimen states that the species is common throughout the area; the bark is brown-tan long-fibrous; the leaves are lustrous, dark green, fleshy, brittle, with a revolute margin, dark green above and medium green below; the flowers have a cheesy fragrance somewhat like Camembert; the phyllaries and inflorescence are light green, rays are bright yellow, disk flowers are darker tan-yellow, and anthers are brownish.

The specimen has been identified as *P. epiphytica*, which it resembles in its vegetative form, but the latter species, from Bolivia and southern Peru, has a very different terminal and broadly corymbose inflorescence.

Pentacalia (subg. *Pentacalia*) **todziae** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Peru. San Martín: Prov. Ríoja, 99 km from Ríoja on road to Pomacocha, elev. 1,900 m, ca. 5°45'S, 77°35'W, 15 Feb. 1985, *Stein & Todzia* 2180 (holotype, US; isotype, MO).

In foliis late ovatis coriaceis in inflorescentiis lateralibus in bracteis primariis subfoliiformibus oblongis in bracteis involucri 10–12 et in capitulis radiatis distincta.

Stout vines of indefinite length; stems terete, striate, glabrescent, fistulose. Leaves alternate, petioles ca. 6 cm long; blade fleshy, drying thick-coriaceous, broadly ovate, ca. 17 cm long, 14 cm wide, base broadly and shallowly cordate, margins entire, apex subacute, upper surface glabrous, lower surface somewhat paler, sparsely puberulous with minute, erect hairs; 6 or 7 secondary veins on each side, more spreading nearer base, prominent on lower surface, some prominent tertiary veins linking secondaries near margin. Inflorescences lateral from axils of vegetative leaves, 2–3 times as long as leaves, with axis minutely puberulous from base, regularly branching at 45–50° angles from near basal fourth; primary bracts foliiform, oblong, to 4 cm long and ca. 1 cm wide in median bracts, smaller below and above; peduncles 0.8–1.5 cm long, selen-

der, minutely puberulous. Heads 10–14 mm high, heterogamous, radiate; calycular bracts 2–4, linear, 2–3 mm long, minutely puberulous; involucral bracts 10–12, sparsely puberulous toward middle and base, ca. 7 mm long, 1.5 mm wide, rather narrowly acute. Ray florets ca. 8; corollas yellow, glabrous, tube ca. 5 mm long, limb ca. 9 mm long. Disk florets 25–30; corollas brownish yellow, glabrous, 8–10 mm long, tube 5–6 mm long, throat 2.0–2.5 mm long, lobes ca. 2 mm long, ca. 0.5 mm wide, tips moderately thickened with numerous enlarged cells outside; anther thecae ca. 1.5 mm long, with basal tails a fourth to three-fourths as long as collar; apical anther appendage oblong, ca. 0.3 mm long, 0.17 mm wide. Achenes 2.0–2.5 mm long, glabrous, 5-ribbed; pappus bristles ca. 9 mm long, not or slightly broadened at tips. Pollen grains ca. 30 μm diam.

The new species has unusually stiff leaves when dry, the lateral inflorescences have distinct, oblong

foliose bracts and large heads with 10–12 involucral bracts. Its closest relation may be to *P. carpishensis*, which has similar fine hairs on the lower leaf surface, but all parts of the latter are much smaller.

Pentacalia vargasiana (Cabrera) H. Robinson & J. Cuatrecasas, comb. nov. Basionym: *Gynoxys vargasiana* Cabrera, Revista Universidad Nacional Cuzco 33(87): 121. 1944 (1945). TYPE: Peru. Cuzco: Prov. Calca, alrededores de Lares, 3,200 m, Vargas 3598 (LP).

A recent collection of the species has been seen: Peru. Cuzco: 9–12 km NE of Paucartambo, 2,980–3,050 m alt., shrub 2 m, Gentry, Dillon, Berry & Aronson 23422 (MO, US). The species was originally placed in *Gynoxys* because of the opposite leaves, in spite of the blunt tips on the style branches. The tails of the anthers are only about a fourth as long as the collar, shorter than those of most members of the subgenus.

KEY TO THE SPECIES OF *PENTACALIA* SUBG. *PENTACALIA* IN PERU (INCLUDING *SENECIO PANTICALLENSIS*, WHICH WAS INCLUDED BY CABRERA, 1985)

- 1a. Leaves opposite.
 - 2a. Vines; leaves glabrous; involucres with ca. 8 bracts; rays lacking *P. wurdackii* (J. Cuatrecasas) J. Cuatrecasas
 - 2b. Shrubs; leaves pubescent; involucres with ca. 13 bracts; rays present.
 - 3a. Bases of leaf blades narrowly cordate, undersurfaces of leaves lanate with fulvous hairs mostly on veins, margins denticulate with sometimes remote teeth; without persistent enlargements on nodes at bases of petioles *P. vargasiana* (Cabrera) H. Robinson & J. Cuatrecasas
 - 3b. Bases of leaf blades rounded to short-acute, undersurfaces covered with grayish tomentum, margins denticulate with very close-set small teeth; nodes appearing enlarged by persistent enlarged bases of petioles *P. balsasana* J. Cuatrecasas & H. Robinson
- 1b. Leaves alternate.
 - 4a. Heads sessile or subsessile, usually clustered, peduncles not more than 2 mm long.
 - 5a. Heads with ligulate ray florets.
 - 6a. Involucre with 8 or 9 bracts; leaves broadly ovate or elliptical, glabrous *P. psidiifolia* (Rusby) J. Cuatrecasas
 - 6b. Involucre with 11–13 bracts; leaves ovate-lanceolate.
 - 7a. Leaf blades woolly or glabrescent below *P. brittoniana* (Hieronymus) J. Cuatrecasas
 - 7b. Leaf blades glaberrimus *P. miguelii* (J. Cuatrecasas) J. Cuatrecasas
 - 5b. Heads disciform, with florets all tubular, with or without peripheral female florets.
 - 8a. Leaf blades densely and persistently tomentose below.
 - 9a. Leaf blades entire; white-tomentose below.
 - 10a. Leaf blades with evanescent arachnoid tomentum above *P. tarapotensis* (Cabrera) J. Cuatrecasas
 - 10b. Leaf blades glabrous above *P. marinii* (Cabrera) J. Cuatrecasas
 - 9b. Leaf blades with mucronate-denticulate margins.
 - 11a. Involucral bracts glabrescent; leaf blades white-tomentose below *P. herzogii* (Cabrera) J. Cuatrecasas
 - 11b. Involucral bracts tomentose; leaf blades with ochraceous tomentum below.
 - 12a. Branches of inflorescence retroflexed *P. oronocensis* (DC.) J. Cuatrecasas
 - 12b. Branches of inflorescence laterally spreading or ascending *P. megaphlebia* (Greenman & J. Cuatrecasas) J. Cuatrecasas
 - 8b. Leaf blades glabrous or with arachnoid hairs or sparse hairs.
 - 13a. Leaves with rounded and abruptly short-mucronulate tips *P. mucronatifolia* H. Robinson & J. Cuatrecasas
 - 13b. Leaves with subacute to acute or acuminate tips.
 - 14a. Heads with peripheral, tubular, female florets.

- 15a. Undersurface of leaf blades woolly with white arachnoid hairs; involucral bracts 8–13, ca. 5 mm long ... *P. subglomerosa* (Greenman) J. Cuatrecasas
- 15b. Undersurface of leaf blades essentially glabrous; involucral bracts 8, 3.5–4.0 mm long.
- 16a. Leaf blades elliptical to oblanceolate; heads sessile
..... *P. loretensis* (J. Cuatrecasas) J. Cuatrecasas
- 16b. Leaf blades ovate-lanceolate to lanceolate; heads shortly pedunculate
..... *P. divisoria* (Cabrera) J. Cuatrecasas
- 14b. Heads without peripheral female florets, all florets bisexual.
- 17a. Achenes villous with setulae *P. comarapensis* (Cabrera) J. Cuatrecasas
- 17b. Achenes glabrous.
- 18a. Involucres with ca. 13 bracts
..... *P. huallagana* (J. Cuatrecasas) J. Cuatrecasas
- 18b. Involucres with 8 or 9 bracts.
- 19a. Inflorescence elongate, often with a distinctly zigzagged axis; involucre 3.5–5.0 mm high.
- 20a. Involucre 3.5–4.0 mm high
..... *P. urubambensis* (Cabrera) J. Cuatrecasas
- 20b. Involucre ca. 5 mm high
..... *P. sailapatensis* (J. Cuatrecasas) J. Cuatrecasas
- 19b. Inflorescence condensed, about as wide as long, with essentially straight axis; involucre less than 3.5 mm high.
- 21a. Leaf blades essentially smooth on upper surface
..... *P. jalcana* (J. Cuatrecasas) J. Cuatrecasas
- 21b. Leaf blades with close reticulum of raised veinlets on both surfaces
..... *P. pomacochana* (J. Cuatrecasas) J. Cuatrecasas
- 4b. Heads pedunculate, peduncles mostly 2–30 mm long.
- 22a. Heads homogamous, with all florets bisexual.
- 23a. Inflorescences terminal on leafy stems *P. chachapoyensis* (Greenman) J. Cuatrecasas
- 23b. Inflorescences mostly or completely lateral from axils of vegetative leaves.
- 24a. Leaf margins denticulate, surfaces nearly smooth
..... *P. huamaliensis* (Cabrera) J. Cuatrecasas
- 24b. Leaf margins entire; reticulum of veinlets raised above surfaces.
- 25a. Leaf blades coriaceous, glabrous, broadly ovate, 7.5–9.5 cm wide; heads numerous in ovate-paniculate inflorescences ca. 30 cm long
..... *P. asplundii* (Cabrera) J. Cuatrecasas
- 25b. Leaf blades herbaceous to subcoriaceous, with some pubescence below, 3.0–5.5 cm wide; heads in racemose or narrowly thyrsoid inflorescences.
- 26a. Bases of leaf blades subrotund; involucral bracts ca. 7 mm long; heads with ca. 20 florets *P. lucidissima* (J. Cuatrecasas) J. Cuatrecasas
- 26b. Bases of leaf blades acute; involucral bracts 4.5–5.0 mm long; heads with ca. 12 florets *P. cutervonis* sp. nov.
- 22b. Heads heterogamous, with peripheral tubular or ligulate female florets.
- 27a. Involucres with 10–13 bracts.
- 28a. Inflorescences mostly lateral from axils of full-sized vegetative leaves, with reduced bracts.
- 29a. Leaf blades broadly ovate, 10–14 cm wide; secondary veins prominent on lower surface *P. todziae* H. Robinson & J. Cuatrecasas
- 29b. Leaf blades oblong-elliptical, 4–5 cm wide; secondary veins not prominent below.
- 30a. Undersurfaces of leaf blades and outer surfaces of involucral bracts with hairs; stems broadly fistulose
..... *P. carpishensis* (J. Cuatrecasas) J. Cuatrecasas
- 30b. Undersurfaces of leaf blades and outer surfaces of involucral bracts glabrous; stems not or scarcely fistulose
..... *P. poyasensis* (J. Cuatrecasas) J. Cuatrecasas
- 28b. Inflorescences terminal on leafy stems, only lowest branches from axils of scarcely reduced leaves.
- 31a. Heads disciform to subradiate ... *P. purpurivenosa* (J. Cuatrecasas) J. Cuatrecasas
- 31b. Heads with distinct ligulate rays.
- 32a. Leaf margins densely crenulate denticulate; corolla lobes sparsely glandulariferous *P. sagasteguii* H. Robinson & J. Cuatrecasas
- 32b. Leaf margins entire; corolla lobes glabrous.
- 33a. Leaf margins broadly recurved
..... *P. tablensis* (Cabrera) J. Cuatrecasas
- 33b. Leaf margins not or scarcely reflexed.

- 34a. Leaf blades subcoriaceous, with veinlets raised on surface; tips of pappus bristles slightly more scabrid, not distinctly broadened *P. nunezii* H. Robinson & J. Cuatrecasas
- 34b. Leaf blades coriaceous, with veinlets obscure; tips of pappus bristles distinctly broadened *P. davidsmithii* H. Robinson & J. Cuatrecasas
- 27b. Involucres usually with 8–9 bracts.
- 35a. Involucre 7–12 mm high; leaf margins usually minutely denticulate; veinlets often translucent.
- 36a. Upper vegetative leaves with auriculate bases ... *Senecio panticallensis* Cabrera
- 36b. Vegetative leaves without auriculate bases *P. dictyophlebia* (Greenman) J. Cuatrecasas
- 35b. Involucre 5–7 mm high; leaf margins entire; veinlets not translucent.
- 37a. Marginal female florets of heads tubular or with limbs only to 2.5 mm long.
- 38a. Involucres and undersurfaces of leaves tomentose *P. disciformis* (Hieronymus) J. Cuatrecasas
- 38b. Involucres and undersurfaces of leaves glabrous or essentially glabrous.
- 39a. Inflorescence a long, narrow, terminal panicle, with many lower branches from axils of scarcely reduced leaves, branches ascending; involucre not turbinate with lower part differentiated at anthesis *P. jelskii* (Hieronymus) J. Cuatrecasas
- 39b. Inflorescence broadly oval to pyramidal, only about twice as high as wide, with some lower branches from axils of reduced leaves, branches widely spreading; involucre turbinate at anthesis, with lower ½ of bracts differentiated *P. maynasensis* H. Robinson & J. Cuatrecasas
- 37b. Marginal female florets of heads with limbs 4–10 mm long.
- 40a. Inflorescences lateral from axils of vegetative leaves, individual inflorescences elongate, narrowly thyrsoid to racemiform
- *P. tillettii* H. Robinson & J. Cuatrecasas
- 40b. Inflorescences terminal, broadly corymbose to pyramidal.
- 41a. Branches shortly puberulous in distal part; leaf blades ovate-lanceolate, somewhat fleshy, glabrous; involucral bracts 5–6 mm long, brownish tomentose; inflorescences cymose-corymbose
- *P. epiphytica* (Kuntze) J. Cuatrecasas
- 41b. Branches densely reddish hispid; leaf blades ovate, membranous, puberulous below; involucral bracts 3–4 mm long, glabrous; inflorescences pyramidal to ovate
- *P. rufohirsuta* (Cabrera) J. Cuatrecasas

NEW SPECIES OF *PENTACALIA* (SUBG. *PENTACALIA*) IN BOLIVIA

Pentacalia (subg. *Pentacalia*) *inquisiviensis* H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Bolivia. La Paz: Prov. Inquisivi, on slopes W of Río Glorieta, and along river between mouths of Río Aballahuanta and Río Cayani 7 km S of Choquetanga, 16°54'S, 67°17'W, 3,150–3,550 m, 19 June 1991, Lewis 38950 (holotype, US; isotype, MO).

In foliis herbaceis oblongo-ellipticis minute denticulatis in nervis puberulis vel tomentellis in inflorescentiis terminalibus patentiter ramosis et in capitulis radiatis longe pedunculatis distincta.

Plants scandent, indefinitely elongate; stems terete, essentially smooth, sparsely minutely puberulous, with solid pith. Leaves alternate, petioles 0.5–1.3 cm long; leaf blades herbaceous, oblong-elliptical, mostly 6–9 cm long, 2–3 cm wide, base narrowly rounded, margins minutely remotely dentic-

ulate, apex acute to short-acuminate, upper surface mostly glabrous, minutely puberulous above on impressed major veins, lower surface tomentellous on major veins, very sparsely tomentellous on surfaces; ca. 8 arching secondary veins on each side, raised above surface below, veinlets dark, not raised above surface. Inflorescence terminal, broadly rounded-corymbose to pyramidal, as broad as high or broader, branches and branchlets widely spreading, lower branches from axils of reduced leaves; bracts of upper axis and branches narrowly lanceolate to linear, 5–15 mm long; peduncles 1.5–4.0 cm long, minutely puberulous. Heads 10–12 mm high, heterogamous, radiate; 7 or 8 calycular bracts narrowly lanceolate to linear, 3–5 mm long, sparsely puberulous; involucral bracts ca. 13, puberulous outside, ca. 6 mm long, 2 mm wide, short-acute. Ray florets 10–12; corollas yellow, glabrous, tube ca. 4 mm long, limb 18–19 mm long, ca. 4 mm wide. Disk florets ca. 20; corollas yellow, glabrous, 9.0–9.5 mm long, tube ca. 4 mm long, throat ca. 4.5 mm

long, lobes 1.3–1.5 mm long, ca. 0.8 mm wide, tips somewhat thickened, papillose outside with narrow cells; anther thecae 2.5–3.0 mm long, basal tails one-third to half as long as collar; apical anther appendage oblong, 0.5–0.6 mm long, 0.22 mm wide. Achenes immature, ca. 4 mm long, glabrous; pappus bristles ca. 8 mm long, tips broadened and more scabrid, with inflated, bluntly pointed apical cells. Pollen grains ca. 40 μm diam.

The locality of this species is described as a *Weinmannia*–*Hesperomeles* forest with *Alnus* predominant along the river. The new species keys to *Senecio yungasensis* Britton in the key by Cabrera (1985), and it resembles Cabrera's illustrations. The Britton species does not seem closely related, having glandular-pubescent stems, upper leaves sessile or subsessile, leaf margins serrate, branches of the inflorescence racemose, and limbs of the rays only ca. 7 mm long. The inflorescence of the new species is one of the most lax with the longest peduncles in the genus. The calycular bracts are larger and more numerous than those of the Ecuadorian and Peruvian species listed above, but are not as prominent as those of the following species.

Pentacalia (subg. *Pentacalia*) **lewisii** H. Robinson & J. Cuatrecasas, sp. nov. TYPE: Bolivia. La Paz: Prov. Inquisivi, "Pavionani," on slope above Pavionani fork of Río Chimu below headwater divide with Río Janko Kalani, area 7 km N of Choquetanga, 16°48'S, 67°18'W, 3,700–3,750 m, 9 Apr. 1991, Lewis 38520 (holotype, US; isotype, MO).

In foliis carnosis ovatis integris glabris in inflorescentiis terminalibus in capitulis mediocriter longe pedunculatis 10–12 mm altis et longe radiatis distincta.

Plants scandent, indefinitely elongate; stem terete to slightly pentagonal, minutely puberulous, not or scarcely fistulose. Leaves alternate, petioles 0.5–1.0 cm long; blades thickly carnose, glabrous, ovate, 2.5–5.0 cm long, 1.5–2.7 cm wide, base obtuse to short-acute, margins entire, apex obtuse to acute, lower surface slightly paler; secondary veins and veinlets indistinct. Inflorescences terminal, broadly corymbose, flat-topped to slightly convex, longer lower branches from axils of full-sized leaves; peduncles 0.8–3.0 cm long, thinly brownish tomen-

tellous. Heads 10–12 mm high, heterogamous, radiate; 6–8 calycular bracts narrowly lanceolate to linear, 7–12 mm long, often longer than involucral bracts; involucral bracts ca. 13, with sparse arachnoid hairs outside, ca. 7 mm long, 1.5–2.0 mm wide, acute. Ray florets ca. 12; corollas yellow, tube ca. 5.5 mm long, limb ca. 8.5 mm long, ca. 2.5 mm wide. Disk florets ca. 35; corollas yellow, glabrous, ca. 9.5 mm long, tube ca. 4 mm long, throat ca. 4.5 mm long, lobes ca. 1.3 mm long, 0.8 mm wide, tip somewhat thickened with nearly smooth, hardened outer surface; anther thecae ca. 3 mm long, with basal tails one-third to half as long as collar; apical anther appendage ca. 0.6 mm long, 0.3 mm wide. Achenes submature, ca. 2 mm long, glabrous, ca. 6-ribbed; pappus bristles 7–8 mm long, tips not or scarcely broadened, with apical cells slightly more projecting. Pollen grains ca. 37 μm diam.

The new species keys to *Pentacalia tablensis* in the key by Cabrera (1985), but the latter has elliptic rather than ovate leaf blades, distinctly recurved leaf margins, and less numerous, short calycular bracts.

Paratypes. BOLIVIA. La Paz: Prov. Inquisivi, "Aguas Calientes de Calachaca," in the area of thermal springs of the Río Calachaca Jahuira, 9 km NW of Choquetanga, 16°48'S, 67°19'W, 3,450–3,500 m, 10 Mar. 1991, Lewis 38305 (MO, US); same locality as holotype, 9 Apr. 1991, Lewis 38524 (MO, US). Collection data indicates the fleshy leaves are either folded inward and secund, or folded downward. In one specimen the pistils of the central florets are said to be bright red.

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